JET PROPULSION LABORATORY INTEROFFICE MEMORANDUM

October 28, 2002

TO: G. Burke

FROM: S. Lineaweaver

SUBJECT: Feasibility of Increased Mars Reconnaissance Orbiter Requirements

REFERENCE: Mars Reconnaissance Orbiter 2005 Support Evaluation, 12 Nov 2001

The Resource Analysis Team performed a feasibility study of two cases of increased Mars Reconnaissance Orbiter 2005 (MRO) mapping requirements for the period of November 6, 2006 through November 23, 2008. This paper focuses on the support that MRO should expect to receive in each case, as compared to the assessment of the mapping phase requirements reported in the referenced November 12, 2001 evaluation, and the ways the increased requirements affect other project support and Deep Space Network (DSN) resources.

We used the FASTER (Forecasting And Scheduling Tool for Earth-based Resources) forecasting system and the updated mission set database from the August 2002 Resource Allocation Review Board to perform the analysis.

View periods used in the analysis of both study cases and in the referenced evaluation were based on SPK file (ID 646) provided by the Project on or about January 10, 2001.

Major changes in the mission set database since November 12, 2001 include:

1. The ASI/NASA Marconi Telecommunications Orbiter launch changed from 09 Sep 2007 to 23 Aug 2007
2. Mars CNES Premier Orbiter 2007 launch changed from 09 Sep 2007 to 11 Sep 2007
3. The Europa Orbiter, Mars Smart Lander 2007, New Horizons, and Starlight missions were canceled. Requirements supporting the missions were deleted from the database
4. Requirements supporting two new missions, Dawn and Kepler, were added to the database
5. Stereo Ahead and Stereo Behind modified prime science requirements in 2006-2008
6. Requirements supporting the CONTOUR Mission were deleted from the database.

Study Case Requirements (November 6, 2006 through November 23, 2008)

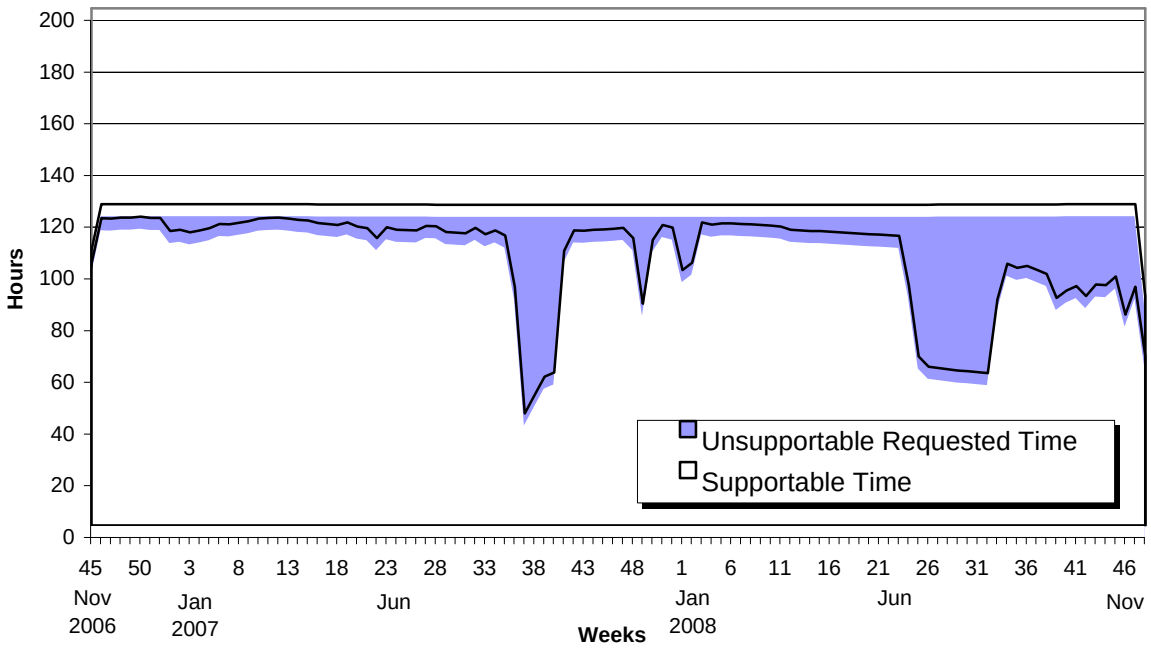
Refer to the attached Case 1 and Case 2 User Loading Profile summaries for weekly "best-fit" distribution of the Case 1 and 2 requirements.

Case 1.	The 34 meter case where requirements are submitted for:	
	34 meter support	8-h passes, 18 passes/week, where 3 to 4 passes/week provide Ka-band downlink support
	70 meter support	8-h passes, 3 passes/week
Case 2.	The 70 meter case where requirements are submitted for:	
	34 meter support	8-h passes, 14 passes/week, where 2 passes/week provide Ka-band downlink support
	70 meter support	8-h passes, 7 passes/week

November 12, 2001 Mapping Assessment

Figure 1, reproduced from the 2001 evaluation, shows MRO's requested and forecast supportable hours from the 2001 evaluation. The chart identifies four periods of time where MRO's supportability declined below 90 percent.

Figure 1. Supportable Time from November 2001 Study
November 6, 2006 to November 23, 2008



Case 1 and Case 2 Assessments

The Case 1 and Case 2 requests for 187 hours per week, including pre- and post-calibration time, represent a 33 percent increase over the request for 124 hours per week

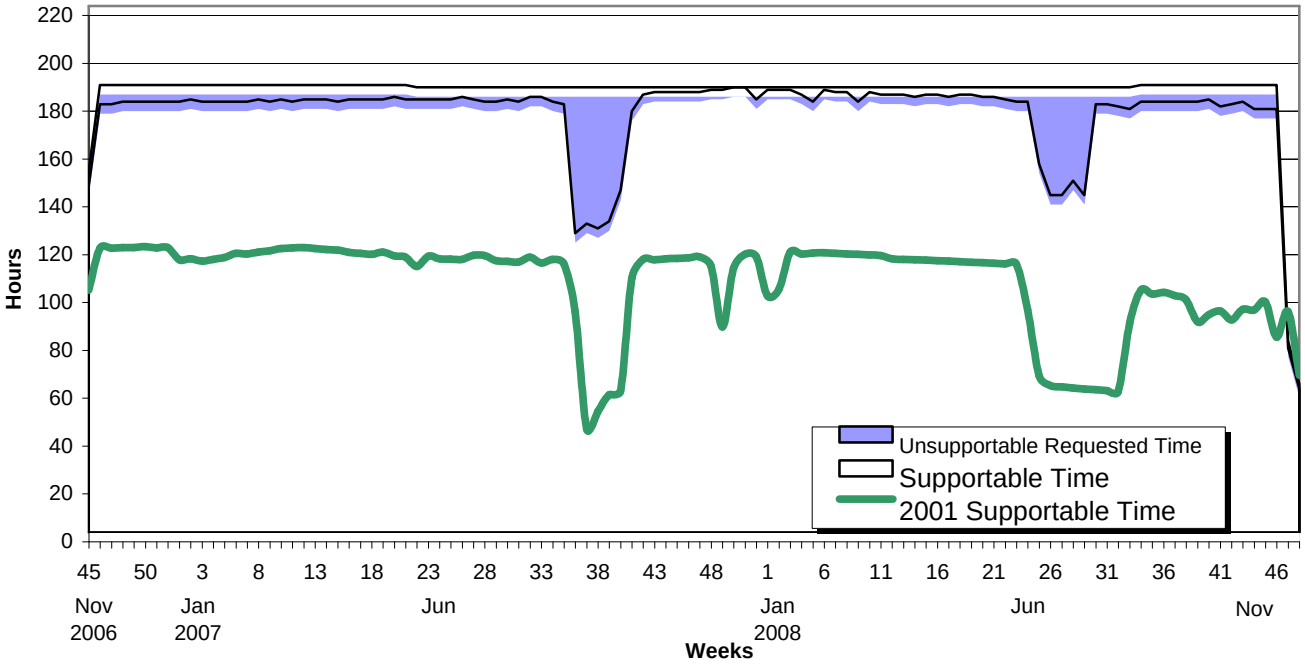
studied in the November 2001 evaluation. In both cases MRO's supportable time is improved in 2007 weeks 49-50 and in 2008 weeks 01-02, 24, and 30-47. The improvement is due to the mission set changes noted above and other changes to user's requirements since the 2001 study.

In both cases, two periods remain where contention with other users in the mission set cause MRO's supportable time to decline below 90 percent.

Case 1 Detailed Assessment, 34 meter

Figure 2 shows the requested hours and forecast supportable time of the Case 1 requirements. The forecast supportable time from the 2001 study is superimposed on the chart for easy comparison. Except in 2007 weeks 36-40 and 2008 weeks 25-29, the Case 1 requirements are forecast above 90% supportable. Outside of the excepted periods MRO should expect to receive nearly all of the support requested.

Figure 2. Supportable Time, Case 1, 34-meter Requirements
November 6, 2006 to November 23, 2008



In 2007 weeks 36-40 the increased MRO requirements are forecast 65 to 80% supportable. DSN 34-meter resources are oversubscribed and the capacity issues reported in the 2001 evaluation are little changed in these weeks. Mars ASI/NASA Marconi Telecommunications Orbiter 2007 (M07T) launches in week 34, Mars Competed Scout 2007 (M07S) launches in week 36, and Mars CNES Premier Orbiter 2007 (M07O) launches in week 37. Each of the three missions requires continuous support on 34-meter antennas from launch to launch + 30 days.

In addition to the three missions requiring continuous support, the MRO Case 1 request requires eighteen 34-meter passes where 3 to 4 passes provide Ka-band downlink support

and Mars Odyssey (M01O) requires one daily 8-hour pass until the end of relay and mission operations in week 38. The MRO, M01O, M07O, M07S, and M07T view periods overlap fully.

A number of other user's view periods overlap the Mars view by more than 50% and the requirements supporting these missions add to the 34-meter overload. Cassini tour requires a daily 9-hour pass, Stereo Ahead routine tracking requires a daily 5-hour pass, MESSENGER routine tracking requires one to two weekly 4-hour passes, Dawn requires a weekly 4-hour pass, and DSS Maintenance requires 6 to 8-hours of weekly maintenance at each of the nine 34-meter antennas. Also, the Reference Frame Calibration Catalog Maintenance and Enhancement and the Space Geodesy Program Crustal Dynamics 24-hour requests conflict with the continuous launch support in various weeks, adding to the load.

In 2008 weeks 25-29 the increased MRO requirements are forecast 76 to 83% supportable. Each of the three Mars 2007 Missions requires continuous DSN support during the respective approach phases. In weeks 25-29 the approach phases overlap, creating an overload on the 34-meter subnet similar to that described during the 2007 launch phases.

In addition to the three missions requesting continuous DSN support, the MRO Case 1 request requires eighteen 34-meter passes/week where 3 to 4 passes provide Ka-band support. The MRO, M07O, M07S, and M07T view periods overlap fully.

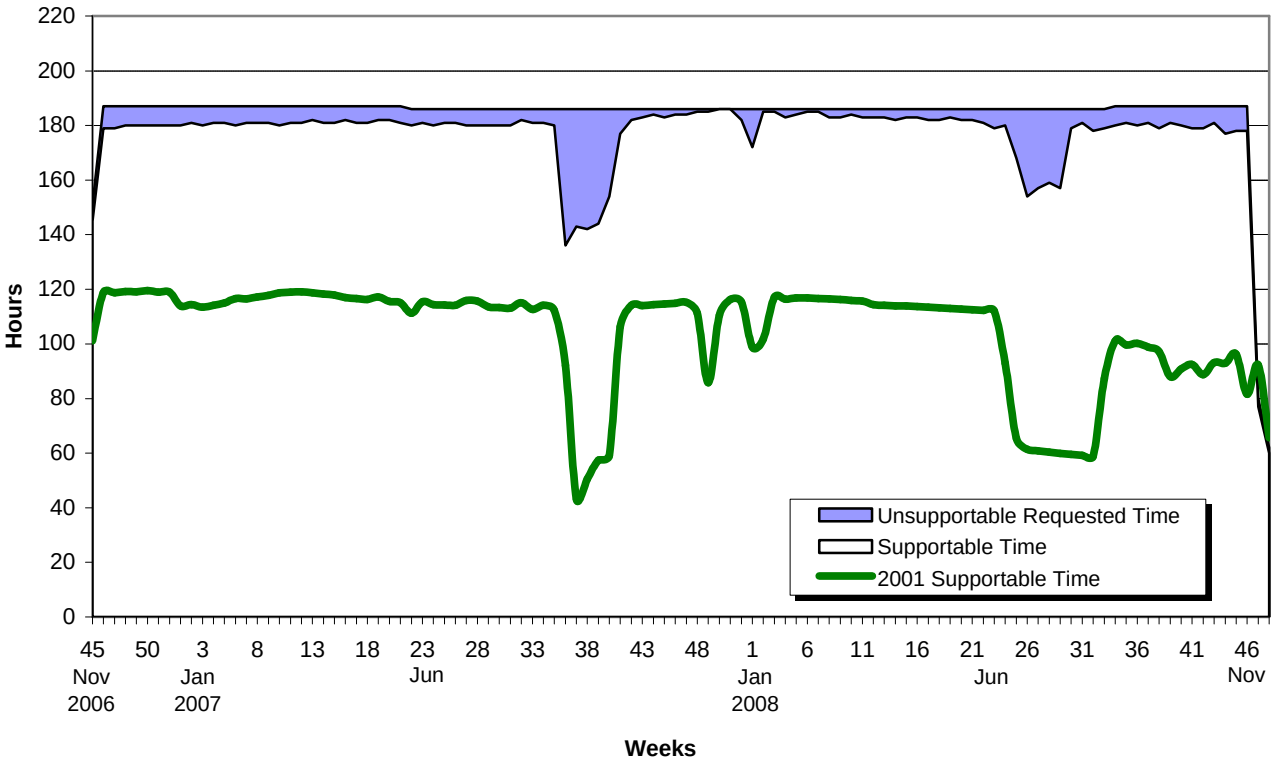
A number of other user's view periods overlap the Mars view by more than 50% and the requirements supporting these missions add to the 34-meter overload. On a weekly basis Cassini tour requires four to six 9-hour passes, DSS Maintenance requires 6 to 8-hours of weekly maintenance at each of the nine 34-meter antennas, Kepler requires two 6-hour and ten 30 minute passes, MESSENGER requires 2 to 7 passes, and Rosetta flyby requires four to seven 4-hour passes. Also, the Reference Frame Calibration Catalog Maintenance and Enhancement and the Space Geodesy Program Crustal Dynamics 24-hour requests conflict with the continuous approach support in various weeks, adding to the load.

The Case 1 request for 70-meter support is forecast above 90% supportable throughout the period studied but additional loading on the subnet in the Mars viewperiod is likely as conflicts on the 34-meter subnet are negotiated.

Case 2 Detailed Assessment, 70 meter

Figure 3 shows the requested hours and forecast supportable time of the Case 2 requirements. The forecast supportable time from the 2001 study is superimposed on the chart for easy comparison. Except in 2007 weeks 36-40 and 2008 weeks 26-29, the Case 2 requirements are forecast above 90% supportable. Outside of the excepted periods MRO should expect to receive nearly all of the support requested.

Figure 3. Case 2, 70-meter Requirements
November 6, 2006 to November 23, 2008



During 2007 weeks 36-40 and 2008 weeks 26-29 the 34-meter Case 2 requirements are forecast to be 70 to 85% supportable. Capacity on the DSN 34-meter resources in the Mars view period remains low due the overload condition described in the Case 1 analysis.

The Case 2 request for 70-meter support is forecast above 90% supportable throughout the period studied but additional loading on the subnet in the Mars view period is likely as conflicts on the 34-meter subnet are negotiated.

Summary

This study reviewed two cases of Mars Reconnaissance Orbiter increased requirements during the mapping phase and compared the results to those reported in the November 2001 evaluation. The 70-meter, 34-meter, and 34-meter Ka-band mapping requirements are forecast above 90% supportable in both cases except during two periods when the DSN 34-meter resources are oversubscribed. Antenna over-subscription, primarily within the Mars view period at the Canberra and Madrid Complexes, occurs after the launch of three new Mars missions in 2007 and again as the three missions approach Mars in 2008.

Due to 34-meter low capacity reported in the Mars view period from 7 Sep 2007 through 7 Oct 2007 the Case 1 requirements average supportability declines to 70% and to 78% from 16 Jun 2008 through 20 Jul 2007. From 7 Sep 2007 through 7 Oct 2007 the Case 2 requirements average supportability declines to 77% and to 85% from 23 Jun 2008 through to 28 Jul 2008.

As always, the results of this study are preliminary in that network loading changes as requirements for planned missions are input and updated.

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